The JOHNSON NATIONAL DRILLERS JOURNAL

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GROUND WATER RESOURCES AND THEIR CONSERVATION

GROUND WATER PROVINCES OF THE UNITED STATES (Continued)

Provinces J. K. L. and M.

J—Black Hills-Cretaceous Province.

K—Great Plains Pliocene - Cretaceous Province.

L—Great Plains Pliocene-Paleozoic Province.

M—Trans-Pecos Paleozoic Province.

A large area in the West known as the Great Plains is represented by Provinces J. K, L, and M. Water conditions vary over a wide range in this area. As a whole, water of some sort is available everywhere, though in many places is not suitable for man or beast. Detailed description of the water-bearing formations is not available except for the better known aquifers. These will be described from such information as is available.

Province J is probably one of the poorest of the ground water provinces, as supplies on the whole are limited in quantity and poor in quality. These unfavorable conditions as far as shallow ground water supplies are concerned are principally due to the fact that the area is underlain by Pierre shale or shales of the White River group. The principal aquifer is the Dakota sandstone which underlies the entire province with the exception of that portion known as the Black Hills.

As has been mentioned in describing the Dakota sandstone found in other provinces, it will yield water wherever it occurs, though in Province J it is far below the surface in most places. In the Black Hills water is obtained from several sources, ranging from the crystalline rocks of pre-Cambrian time to the sedimentary rocks of Tertiary time.

From the standpoint of ground water, the Black Hills are a question mark. Geologically they are of extreme interest as they represent a dome-shaped ridge about 125 miles long and 60 miles wide which rises above the surrounding country and in which are found formations ranging from the oldest to youngest. The region affords a rare opportunity for geology students. The structure along the sides of the uplift dip toward the surrounding plains, the oldest sedimentary rocks forming an escarpment facing the crystalline rock area, and each stratum passes beneath a younger one in regular succession. In the area we find the Deadwood sandstone at great depth, moving upward through the Whitewood limestone, the Mississippian limestones and Minnelusa sandstone. Then the Minnekahta limestone of Permian time. Above these are Spearfish and Sundance shales and gypsum beds. Still higher we pass through the Morrison shale to the Lakota sandstone and then through the Fuson sandstone to the Dakota sandstone. Above the Dakota are the Benton shales, Graneros, Greenhorn and Carlisle. The calcareous deposits of the Niobrara are next above and then the Pierre shale which occupies many thousand square miles of the country adjoining the Black Hills. The presence of this formation accounts for the poor ground water conditions found in south-central and western Dakota. The highest group known as the White River composed the Chadron formation and Brule clay form the Badlands of South Dakota lying between the Cheyenne and White Rivers in western South Dakota. These deposits are practically devoid of ground water.

Farther east in Washabaugh, Meyer, Tripp and Gregory Counties the ground water conditions are somewhat better, though far from

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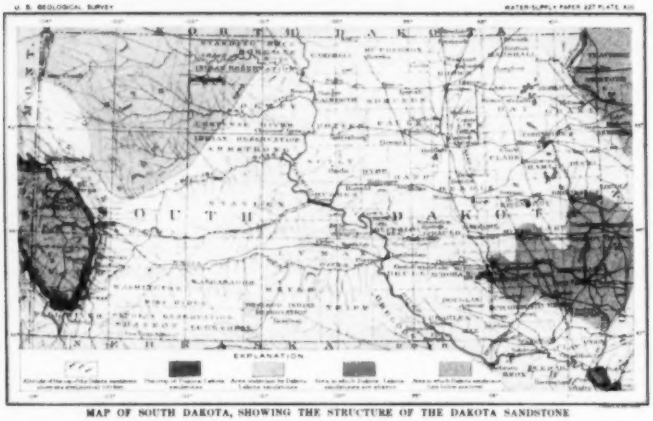
We are now going through a period of uncertainty and waiting as far as our future supply of material is concerned.

Our application for an allotment of materials under CMP which goes into effect July first has been made, but we do not know how much material we are going to get nor when.

This means that we may be faced with a shortage of material until such time as the new control plan is in full effect and operation.

Our customers should have this situation in mind when planning work where screens are to be used and help us by placing orders as far in advance as possible.



MAP OF SOUTH DAKOTA, SHOWING THE STRUCTURE OF THE DAKOTA SANDSTONE

GROUND WATER PROVINCES OF THE UNITED STATES

(Continued from Page 1)

being good. In Gregory County, which lies in the southeast corner of Province J on the west side of the Missouri River, the higher areas are overlain by Pierre shale which is capped by more recent deposits. The thickness of the Niobrara formations is about 200 feet underlain by 400 feet or more of Benton shales lying on the Dakota sandstone which contains artesian water. The old well at Fort Randall secured its supply from this formation at a depth of 700 to 800 feet along the Missouri River.

The Pine Ridge Indian Reservation is in that part of Province J lying east of the Black Hills, between the valleys of the Cheyenne and White Rivers. Its high table lands and plains also contain some typical bad lands. The Dakota sandstone underlies the area at depths varying from 1,100 to 2,300 feet.

It should not be concluded that the only ground water in Province J is found in the Dakota sandstone. As a matter of fact, water is found in at least seven other formations all below the Dakota such as the Lakota, the Morrison formation where it contains sandstone, the Unkpapa sandstone, the sandstone members of the Sundance formation, the fine red sandstone in the Spearfish and the sandstone members in the Minnelusa and Deadwood formations. The small areas of Province J lying in the northeastern corner of Wyoming and the northwestern corner of Nebraska are similar to those which have been described in the southwestern part of South Dakota.

Province K, the Great Plains Province, covers the western half of Nebraska, the northwestern one-third of Kansas, the eastern half of Colorado, the southeastern corner of Wyoming, and a small area in the northeastern part of New Mexico. The principal water-bearing formations of this province are the late sands and gravels of Tertiary time. These deposits are widespread over extensive areas underlying the smooth and almost uneroded plains on the surface. They yield large quantities of water to thousands of shallow wells. Underlying the province are the sandstones of the Dakota formation which also are water-bearing under artesian pressure; however, the Dakota is so deep over much of the area that few wells are drilled into it.

There are places in Province K where the younger Tertiary beds are absent or drained by erosion and the Dakota is buried under hundreds of feet of shale. There are many places like this in eastern Colorado where it is practically impossible to develop a well supply for domestic use or stock watering. About the only source of water in these areas are sand and gravel deposits in the larger stream valleys.

The ground water situation in the Lodgepole Valley where Wyoming, Colorado, and Nebraska is typical of this region and also of interest as Lodgepole Creek is a perfect illustration of an interrupted stream (one which contains perennial stretches which flow continuously, also ephemeral stretches between its source in Wyoming and its juction with the South Platte River near Julesburg, Colorado.)

Its valley resembles other valleys in the Great Plains in that it is a flat bottomed trench with steep sides, which has been formed by stream erosion and then filled with stream deposits. The Lodgepole Valley is underlain by sedimentary formations of great thickness lying on pre-Cambrian granite. The surface formations are those of Tertiary time such as the Ogallala formations of poorly sorted deposits of clay, sand, and gravel with calcareous cement. Immediately below are the sands, gravels, and boulder beds of the Arikaree formation. Occasionally thin beds of limestone are found in this formation. Below the Arikaree the sandy clays of the Brule formation are found and lowest of all are the sand, gravels, and sandstone of the Chadron formation.

Inasmuch as water supplies are obtained from these formations, they admit of more detailed description. Not too much is known regarding the Chadron sands in this area as they are too deep for the average water well. The Brule

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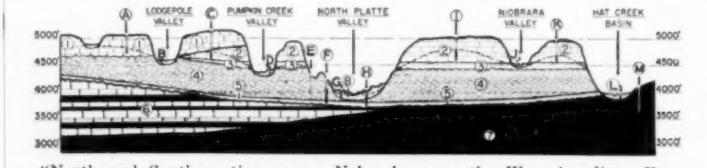
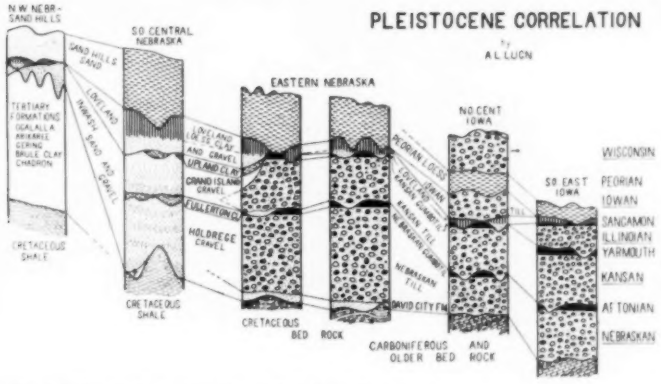


"North and South section across Nebraska near the Wyoming line. Formations (1) Ogallala, (2) Hemingford-Harrison-Monroe Creek, (3) Gering, (4) Brule, (5) Chadron, (6) Lance, (7) Pierre."



"Nebraska Bulletin No. 10—After Lugn."

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clay is at or near the surface over most of Lodgepole Creek Valley. It is a moderately hard, silty clay often pink in color. It is full of joints, crevices, and cracks near the surface which form a more or less integrated system of water channels, that are drawn upon for many domestic and irrigation wells. In a well at Julesburg, Colorado, a well 400 feet deep, 160 feet of "yellow clay," probably Brule clay, was found below the surface alluvial sands and gravels. Below this clay was a few inches of sand, below which blue shale was penetrated 200 feet.

The Arikaree found above the Brule clay consists mostly of soft, fine grained, light gray sandstone containing large concretions or cemented material. It contains water in many places but it is not a high yielder in this area. Above the Arikaree is the Ogallala formation consisting of irregular beds of poorly sorted clayey, sandy and gravelly materials oftentimes cemented. These formations do not sound like good water-bearers but they do contain water and will yield supplies sufficient for the purposes of the area.

The largest supplies are obtained from the alluvial sands and gravels of Recent time. The valley proper is underlain with coarse sand or gravel of thickness varying from 10 to 15 feet at Pinebluff, Wyoming, to 40 feet or more at Julesburg, Colorado. These deposits are heavily drawn upon for irrigational, municipal and industrial supplies. The surface deposits being sedimentary in nature are filled with water to the levels shown in wells. This surface is not level but slopes downstream at the same rate as the valley floor.

A cross-section of western Nebraska from the Lodgepole Valley to the Niobrara Valley shows the Chadron formation outcropping north of Pine Ridge from Wyoming eastward through Sioux and Dawes Counties of Nebraska and into South Dakota, and in the North Platte River Valley from the western part of Scotts Bluff County into Wyoming. This formation underlies the western part of Nebraska west of a line between Kieth and Cherry Counties.

The Brule clay is exposed widely north of Pine Ridge and at places in the North Platte, and Pumpkin Creek Valleys. It underlies a large area in western Nebraska. The formations of the Arikaree group are also exposed in several counties and they extend southward to the Platte River Valley. In Box Butte County in northwestern Nebraska the Hemingord formations are exposed. They form a belt south of the Pine Ridge from Sioux County eastward past Hay Springs, Rushville and Gordon.

The Ogallala beds rest on these formations and extend eastward on older formations to Crofton, north of Grand Island and southeast of Franklin. The Pleistocene geology of the western two-thirds of Nebraska is described in Bulletin No. 10, Nebraska Geological Survey, in great detail by Dr. A. L. Lugn. To anyone not familiar with this section of Nebraska, the geology is difficult to follow as a large area in the north-central part of the state is described as Sand Hills. Further east is the "Till Border." Over much of the area there are heavy deposits of loess. Altogether the area is a vast sponge taking in tremendous quantities of water from precipitation and streams. There is no place in the area where ground water is not available, usually at depths not exceeding 100 feet. To describe the various deposits would take considerable time and space as there are at least nine separate and distinct unconsolidated formations in south-central Nebraska, varying from alluvial, loess, sands, gravels, clays and silts in a wide variety of texture and occurrence. The portion of Province K lying in Nebraska is probably the largest area with an inexhaustible water supply in the United States. In one stretch of the Platte River Valley from Grand Island westward to North Platte there are over 4,000 irrigation wells to say nothing of the domestic, municipal

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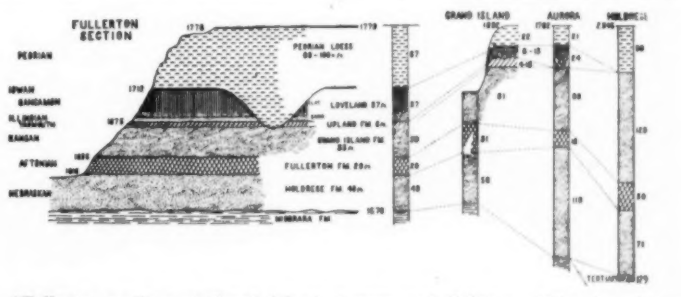

"Fullerton sections at Grand Island, Aurora, and Holdrege, Nebraska—After Lugn. Nebraska Bulletin No. 10."

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and industrial wells in the region.

In Kansas the conditions in Norton and Phillips Counties is typical of a large area in the north and western part of Kansas lying in Province K. The Great Plains in this region are composed of relatively flat deposits of Cretaceous age and younger. In Norton County the outcropping rocks are of late Cretaceous, Pliocene, Peistocene, and Recent. The Niobrara formation underlies the entire area and the surface is covered with nonmarine deposits above the Niobrara which is mostly chalks and clays. There are local deposits of Pierre shale. Above this is the Ogallala which is a mixture of silt, sand, gravel, and cemented material. Locally this formation is known as "mortar bed"; however, this formation holds considerable water though it does not give it up freely, except where the coarser sands and gravels are found.

Above the Ogallala are the surface formations, such as the Meade and Sanborn which are mostly silt with some lenses of sand and gravel. These formations are usually found above the water table and are not reliable sources of ground water.

One of the principal sources of water in this region are the sand and gravel deposits found under the terraces along the main streams. These deposits are mostly of Recent age and were laid down when the streams were formed. They constitute an important source of water for all purposes as they lie below the surrounding country and are supplied by aquifers lying higher in elevation.

In the major stream valleys there are also alluvial deposits consisting mostly of sand and gravel. These deposits contain large quantities of water and if continuous with the deposits under the terraces make a dependable source of supply. The supply of Norton, Kansas is obtained from deposits underlying the terrace along Prairie Dog Creek. Pumpage has been as much as 175,000,000 gallons annually.

In the eastern half of Colorado the same geologic formations are found as in the western part of Kansas. The formations of the region date from Paleozoic time when the first sediments were deposited on the older basement crystalline rocks. During the ages the area was alternately flooded and then dried up. Thick deposits were laid during and after each flood. During Cretaceous time which was a period of erosion at first followed by a flood the Kiowa shale was laid down. As the seas retreated Dakota sandstone was deposited. Then came more floods with deposits of shale, such as the Greenhorn, Carlisle, Niobrara, Pierre, etc. Following this the Rocky Mountains began to rise, the sea pulled back and sandstone, shale and coal of the Laramie

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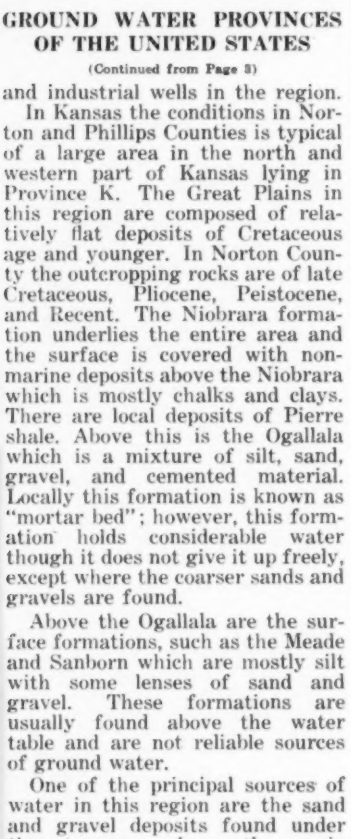
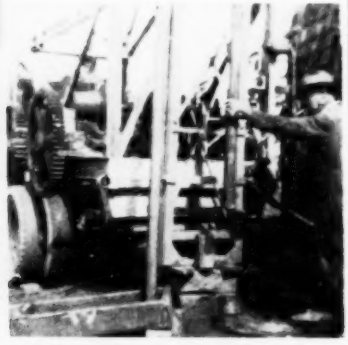


"Sections of Black Hills, Big Horn Mountains, North end of Laramie Range and Hartville Uplift."



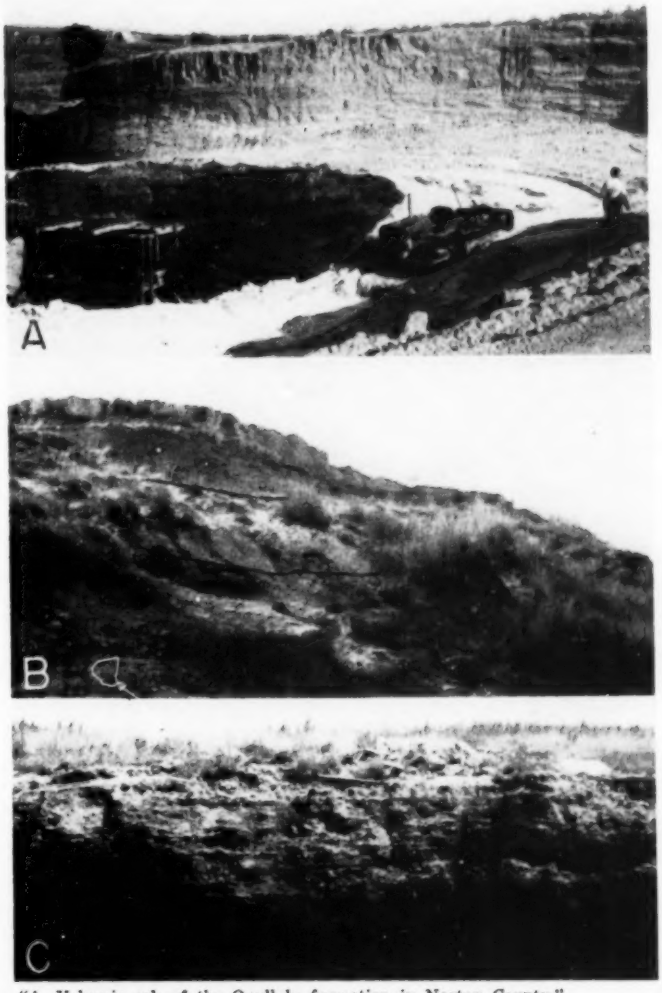
This is a picture of a well being drilled for a Boy Scout Camp in Nova Scotia. The driller is Carl McLean operating one of the rigs of Hingley Well Drillers at Truro, Nova Scotia.

(Continued from Page 4)

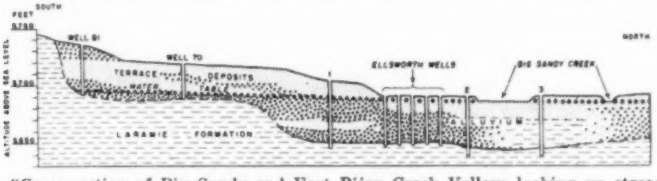
formation were deposited by streams.

Following continued uplifting of the mountains sediments were deposited in successive order which are known as the Laramie and Dawson arkose. Water can be obtained from the sandstone beds in the Dawson but it usually is too deep for wells. Next above is the Castle Rock conglomerate which is below the Ogallala, a water-bearing formation. In the Big Sandy creek area in central-eastern Colorado this formation furnishes many wells with water. In more recent years in geologic time deep valleys were eroded by the streams flowing eastward from the mountains, but as the valleys filled with sediment the streams could not longer carry their loads of sediment and there is little evidence on the surface today of the prehistoric valleys. However, more recent valleys have been formed on the surface which are filled with alluvium. Thus it is not unusual to find the sands and gravels laid down by the earlier streams in the terraces alongside the present streams.

As a whole the eastern half of Colorado is not good from the standpoint of ground water. There is usually sufficient for farm and stock wells, but not for irrigation projects requiring large amounts of water. There are exceptions, however, and one of these is in the Big Sandy Creek area where fairly large supplies are available at reasonable depths. There are many springs and seeps in the Big Sandy area which are used for watering livestock. Near two reservoirs were built to capture the flow of springs. Seepage from the reservoirs caused the water table to rise sufficiently to sub-irrigate 40 acres of alfalfa. Four towns, Limon, Simla, Ramah, and Calhan all obtain their water from either terrace deposits of coarse clean sand and gravel.



"A, Volcanic ash of the Ogallala formation in Norton County."
"B, Exposure of Ogalla formation NW¼ - NE¼ - 36-2-25."
"C, Cemented upper portion of volcanic ash south of Almena, Kansas—Kansas Bulletin No. 81."



"Cross-section of Big Sandy and East Bijou Creek Valleys looking up stream. Through Ellsworth Wells. Colorado Bulletin No. 1."

Province L, still in the Great Plains, is known as the Great Plains-Pliocene-Paleozoic province. It all lies south of Province K and covers a portion of southwestern Kansas, the Panhandle of Oklahoma and Texas, and rather large areas along the eastern border of New Mexico.

Naturally the same principal sources of water are the sands and

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Mr. W. J. McClure of Vineyard Haven, Massachusetts, operates a well drilling business known as the Tashmoo Well Drilling Company. He operates in sand and gravel almost entirely, his wells running from thirty to two hundred feet deep. This keeps a 35 Armstrong and a 40 Keystone busy the year around. The picture is of a well being drilled on Martha's Vineyard Island.

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(Continued from Page 5)

gravels of late Tertiary and Quaternary time. In general, water conditions in the area compare favorably with those in Province K.

The entire province is underlain by Permian formations known as Red Beds. These formations are not good aquifers and generally indicate the lower limit of supplies, from the surface formations. In places the sedimentary Tertiary deposits are missing or thin and therefore little or no water is available.

The conditions along the New Mexico-Texas border are typical of much of the area in that excellent supplies are obtained from the Ogallala sediments over much of the area and from the valley fill in Portales Valley. Geologically the area was created in a manner similar to all of the Great Plains being due to extensive erosion of underlying beds followed by heavy deposits of sedimentary material. The surface deposits are therefore capable of holding large quantities of water. The prehistoric stream beds have been traced by geologists but these early valleys were filled with alluvium so that the area is now a gently sloping plain, except for the main drainage streams. The evidence of the wind at work is noticeable by the presence of surface depression and small ponds which fill with water.

Due to heavy pumping for irrigation in the vicinity of Portales, New Mexico and the Plainview-Lubbock area of Texas there has been a gradual lowering of the water table in the heavily pumped areas which has lead to some restrictive measures in order that the supply be conserved and at the same time support the economy of the region.

Many investigations have been made, some of them recently, to establish the annual safe yield of some of the critical areas. In Progress Report No. 7 of the Texas Board of Water Engineers, Table No. 1. gives the following description of the formations found in the southern High Plains in Texas. Starting at the surface:

Quaternary — Recent series, 0-15 feet thick, mainly stream-channel and wind-blown deposits, also Pleistocene series, 0-150 feet thick, clay, silt, marl, sand and conglomerate and caliche.

Tertiary — Pliocene Series, 0-400 feet thick, clay, silt, fine to coarse sand, gravel and caliche.

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Stewart Bros. at Schenectady, New York, are set up in a modern store, shop and office. They are equipped and experienced in all types of drilling and well work in their area.

This is a 50 Keystone rig owned by Peter Pettini & Sons in Connecticut. The well being drilled was 65 feet and flowed 9 gallons per minute when finished.

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Cretaceous — Lower Cretaceous Series, 0-80 feet thick limestone, blue shale, blue and yellow clays, also sand, gravel and sandstone.

Triassic, 50-1500 feet thick, dark red shales, sandy shales, sandstone and red shale.

Permian, 5,000 feet thick, soft red shales, red clays, and shales interbedded with gypsum, limestone and dolomite.

In the same report the following data regarding the water table lowering is given:

Acres Affected	Decline 1938-49 in feet
1,100,000	0- 5
700,000	5-10
500,000	10-15
118,000	15-20
29,000	20-25
11,400	25-30
7,400	30-35
3,700	35-40
3,400	40-45
2,800	45-50

While the formations vary considerably from place to place, as far as yield is concerned, it is apparent that more water is available for beneficial use in this area. It will be essential, however, to limit future developments to the safe annual yield, otherwise the entire economy which has been built up to date may be forced to reduce its production. Estimates of ground water use in 18 counties in the High Plains in Texas for irrigation alone are approaching 1,400,000 acres for 1950 taken from approximately 10,500 miles.

It might be said that Province M lying west of Province L is almost entirely in New Mexico. This province is known as the Trans-Pecos Palezoic province. Most of the province is not favorable for the development of large quantities of ground water. In the Pecos River Valley, however, the limestones and sandstones of Carboniferous Age yield large quantities of hard water which is extensively used for irrigation, domestic and livestock uses.

Parrot — The only creature gifted with the power of speech that is content to repeat just what it hears without trying to make a good story.

Husband—"Are you ready yet, dear?"

Wife—"I wish you would stop nagging me. I have told you three times in the last hour that I would be ready in a few minutes."

—Gosport.

Cutie Cathead got a beautiful watch case from her boy friend for her birthday. She expects to get the works on Christmas.

William Houser and Sons have drilled wells in the south-central area for many years. The man on the left is Mr. Houser with his son, Ralph, on the right. The well being drilled was finished in sandstone at a depth of 70 feet. It produced 20 gallons per minute with a 4-foot drawdown.

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DRILLERS NOTICE— NEWS RELEASE

For some months there has been considerable effort put forth on the part of a number of people to try and get some recognition of the importance of water supply and waterworks activities in relation to the defense program.

The American Water Works Association and the Water and Sewage Works Manufacturers Association have been working hard on this problem ever since September, 1950. The progress was slow and disheartening. However, they used every possible avenue of approach and kept pounding in spite of their failures until at long last on May 24, 1951, a DPA Order No. 1 was issued which officially assigns responsibility for presenting requirements for materials and recommending priorities in water works construction, operation and maintenance to the National Production Authority (NPA).

In effect, this action says positively that water supply, both ground water and surface water, for industries and municipalities is an important program related to the defense effort.

Although drilling contractors and others closely connected with industrial and municipal water supply understand clearly the importance of this basic resource, the action mentioned above is the first official recognition of that fact under the present defense mobilization set-up. This is a highly important first step in making materials available under the Controlled Materials Plan.

The Water Resources Division is now being reorganized. (No final order for this Division has been received from N.P.A. prior to June 22. —Editor) Mr. Harvey Howe of Lock Joint Pipe Company was induced to head this Division of Water Resources until such time as he could build up the necessary personnel and get the Division working smoothly and efficiently. Mr. Howe is a most capable and understanding man and will, beyond any question of doubt, do an excellent job for the drillers.

Ground water development —water well construction in particular—will be included in

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the activities of this Division. Several branches will handle the various phases of water supply. The branch charged with the water well job will compile and present officially the best possible figures on the amounts of all materials required for essential water well construction and do all it can to get these materials allocated for this work. It will also recommend priorities for water well construction and control of pipe and other well supplies in accordance with the priorities set-up. It will probably have an industry advisory committee representing the water well business as a whole, including large well drillers, medium-sized and small operators. In this manner, every type of drilling operation will have its particular problems presented.

The Water Resources Division will in all probability utilize the U. S. Public Health Service, the U. S. Geological Survey and the Housing and Home Finance Agency as principal advisory agencies as well.

To those of us who are familiar with the necessity and importance of water supply it does not seem possible that it would require any effort to have it recognized for what it is. If we could look over the many letters that were written, could know of the numerous meetings with government officials and could realize all of the time that was spent by the leaders and officers of the American Water Works Association, we would understand readily that the public as a whole is still uneducated and perhaps only mildly interested in water. Beyond any doubt, there is a very fertile field for the well drilling industry in public relations.

We have heard of drillers taking a drink after bringing in a good well—but this is the first time we have ever noticed them washing.

A definite contribution to the status of water well construction under defense mobilization has been made by the above-named organizations for which all the well drillers' associations and also the many drillers who do not belong should be duly appreciative.

Now, then, just how will this get you drillers the materials you will need? Details are still lacking but will be given you in the next issue of the Journal if they are available by that time. However, it probably will work like this: The Water Resources Division will request that certain quantities of materials be allocated or set aside for water supply. Manufacturers of products which you use will then be better able to obtain what they require—and so on, to you.

Insofar as pipe is concerned, this material will be supplied by means of the Warehouse order which was recently issued by NPA and is officially called M-6 Merchant Trade Products. Under this order each jobber is allotted a certain amount of pipe free of priorities for the time being and until another regulation is issued putting jobbers under the CMP plan. No information is as yet available regarding the proposed CMP plan.

This should make it possible for your suppliers to get pipe so you can get it. You know from past experience that there may be some rough spots but it looks as though they can and will be ironed out. We must as usual have patience.

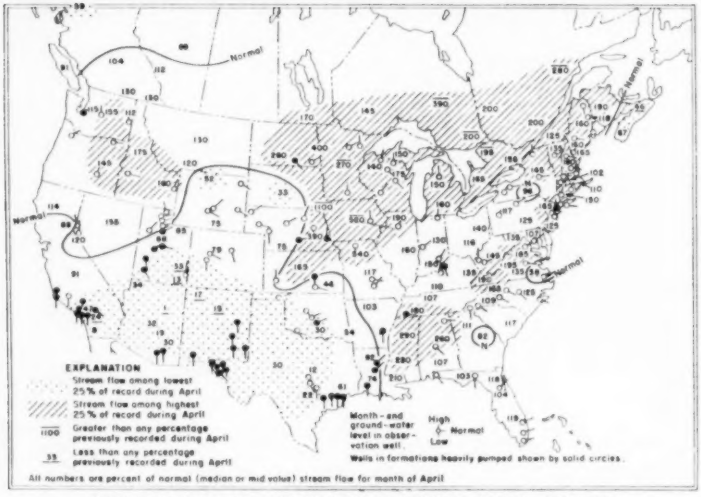
The main thing, however, is that the water well drilling industry has at long last some one who is interested in it and who will go down the line for it.

Our special appreciation goes to Harry Jordan, the tireless Secretary of the American Water Works Association, for the splendid job he helped engineer.

First Old Maid (reading newspaper): "It says here that a woman in Omaha has just cremated her third husband.' '

Second Old Maid: "Isn't that always the way. Some of us can't even get one, and others have husbands to burn."

SURFACE and GROUND WATER CONDITIONS


Normal
EXPLANATION
Stream flow among lowest 25% of record during April
Stream flow among highest 25% of record during April
100 Greater than any percentage previously recorded during April
33 Less than any percentage previously recorded during April
Month-end ground-water level in observation well
High
Normal
Low
Wells in formations heavily pumped shown by solid circles.
All numbers are percent of normal (median or mid value) stream flow for month of April

STREAM FLOW AND GROUND WATER IN RELATION TO NORMAL, APRIL 1951

The March Water Resources Review of the situation reports record breaking local floods in Iowa and several eastern and southern states. The serious drought in the Southwest persisted with little relief in sight.

Ground water levels were generally above average in the northern states. In southern states ground water levels were quite low with some record low levels observed.

At the end of the six months' period, October, 1950 to March 31, 1951, ground water levels in the Coastal Plain areas of the South Atlantic and eastern Gulf of Mexico states were well below normal for much of the period. Drought or near drought conditions prevailed in many parts of Texas throughout the period and new record low ground water levels were reported nearly every month, especially in the heavily pumped areas of Houston and El Paso.

In the East, water levels in the Flatbush section of Brooklyn rose as much as 19 feet during a 3½-year period, June, 1947, to December, 1950. This rise was due to a cessation of pumping by the New York Water Service Corporation who had supplied that area with ground water for 50 years. The withdrawals for public use approximated 27 million gallons per day in 1947. At this time New York City refused to renew the franchise on account of the marked increase in the salinity of the water and the fact the water levels were over 30 feet below sea level.

In April major floods occurred in the Minnesota and the Upper Mississippi River basins. Runoff and ground water levels were generally well above normal throughout the Great Lakes states and New England. The drought in Texas and the Southwest continued.

In Michigan substantial ground water recharge was noted throughout the state and in Wisconsin runoff and ground water levels were high due to melting of the heavy snow cover. In the Northeast ground water levels were about normal or above in Maine, Massachusetts, Connecticut, and Rhode Island.

In the Southwest low ground water levels were noted at Austin, Texas, as well as at Houston and El Paso. Farther north in Nebraska ground water levels were below normal in the southern part with record lows at Keystone and Columbus. An 18-year high was observed at Ashland in the vicinity of the City of Lincoln well field.

In the West ground water levels reached a new high in two observation wells, while the opposite was indicated in two observation wells in Colorado. Ground water levels in western Nebraska were record high for April at Reno and Steamboat. Pumping for irrigation caused a continued decline in ground water levels with new April lows observed at a number of key wells. Ground water in Arizona remained low, while in New Mexico pumping for irrigation generally caused declines in ground water levels with municipal supplies at Santa Fe and other towns critically affected.

Testing 12-inch well at Junction City, Kansas, constructed by Jungmann Bros. of Topeka. Depth 71 feet producing 1,000 g.p.m. with 17-foot drawdown. Mr. Virgil Basgall, City Manager, checks output.

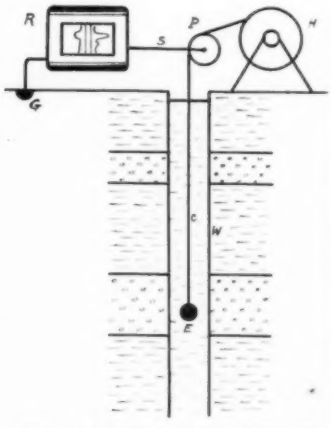
Martin Sundin's camp and rig on the South Saskatchewan River in Canada. Drilling test holes for P.F.R.A. Dam project in winter 1950-51. Mr. Sundin drills wells for all purposes in that region.

ELECTRIC LOGGING

Editor's Note:

The use of electric logs to determine the nature and depth of deep lying ground water formations is something most of us know little about.

For this reason we are publishing the following article prepared by Mr. Hubert Guyod, President, Well Instrument Developing Company of Houston, Texas.



"Fig. 1—Principle of resistance measurement in a bore hole."

"The development of a ground water supply of oftentimes is preceded by a careful investigation of the water-bearing formations available in the area under consideration.

"The manner of making such investigations has been discussed at length in ground water literature and the methods used have been more or less standardized. However, a new technique known as electric logging has been developed in recent years and used with success in deep formations. The questions to be solved are the same regardless of the method used. These questions are: (1), accurate location of the water-bearing stratum or strata as the case may be; (2), a determination of the chemical characteristics of each acquifer; and (3), an estimate of their yielding ability.

"Electric logs were developed and first used by the oil companies for solving similar problems in the oil and gas field. It is only in recent years that these methods have been used in connection with holes drilled into water-bearing formations.

"The basic principle of electric logging is the measurement of two electrical quantities, i.e., electrical resistance and electrical potential. The electrical resistance of most formations is determined entirely by the chemical nature of the water in the formations penetrated. Naturally the electrical resistance varies appreciably between one formation and another in a drill hole. Therefore, resistance measurements are usually made by means of an arrangement similar to that shown in Figure 1. An electrode E attached to the end of an electric cable C is lowered into a well or drilled hole W, by means of a reel or hoist H. The upper end of the cable is connected to a recording instrument R, placed at the surface. The cable passing over a calibrated pulley P drives a strip of chart paper upon which the resistance measurements are automatically recorded in terms of depth.

"Potential measurements are made with the same recording equipment as resistance measurements, except that the circuits are somewhat modified since the measurement is made in a different electrical unit. Inasmuch as potential measurements also vary with the type of formations penetrated by the drill hole and the water contained in the formations, a voltmeter V (see Figure 2) is connected between an electrode E placed in the drill hole and a ground G located at the surface. The difference in potential between points E and G can then be observed. This difference in potential, usually referred to as 'potential,' varies as E travels up or down in the hole.

"All of the measurements are easy to make and simple electrical

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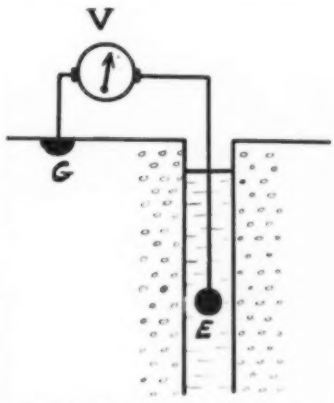

"Fig. 2—Principle of potential measurement in a bore hole."

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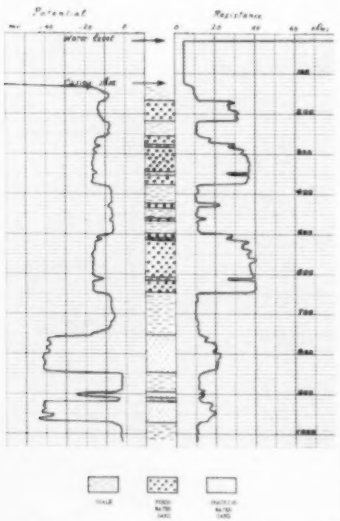
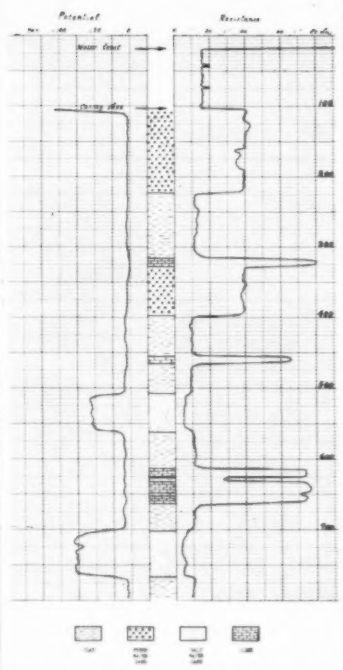
logging instruments have been designed for this purpose. Both resistance and potential are recorded simultaneously on the chart paper.

"That electric logging is useful in determining the depth, thickness, and freshness of water-bearing formations is obvious from the electric log of a water well drilled near Houston, Texas, shown in Figure 4. In this area the formations are principally clays and sands characterized by high resistance in the fresh water sands and low resistance in the clays. When resistance decreased and potential increases at the same time this indicates a change in the chemical nature of the water from the formation indicated.

"Figure 5 is an electric log of a water well in southern Illinois constructed in shales, sands, and dense limestones. The resistance values of 30 to 50 ohms above 485 feet indicate fresh water sands, while higher values correspond to limestones. Brackish and salt water sands are indicated in the log below 185 feet by relatively low resistance values and high potentials. On the other hand heavy beds of limestone are indicated by high resistance values in the brackish or salt water zone.



"Fig. 4—Electric log of water well near Houston, Texas."



"Fig. 5—Electric log of water well in Illinois."

"The foregoing examples of the use of electric logs show that such methods are useful in the field of ground water. For shallow wells in the ground water field the apparatus is not bulky nor too difficult to operate. Such a unit weighing about 100 pounds is shown in Figure 6, and is capable of logging holes 500 feet or less in depth. For deeper holes larger and heavier equipment is used."

From the foregoing article of Mr Guyod's it is apparent that the success of full application of electric logging in the water field is basically one of intelligent and accurate interpretation of the chart record. For exact log information it is also apparent that supplemental methods would have to be used. Inasmuch as formation samples are not taken, it is problematical how beneficial electric logging is as far as estimates of water yield are concerned. It would seem then that the principal benefit of electric logging would be in prospecting or investigating proposed sites of ground water developments.

ASSOCIATION NEWS

This section is devoted to the exclusive use of water well drillers' associations, both state and local. Notices, announcements, changes of officers and other items should be sent to The Editor, Johnson National Drillers' Journal, 2304 Long Ave., St. Paul, Minnesota.

PENNSYLVANIA MEETING

Both divisions of the Pennsylvania Water Well Contractors Assocation met at the Green Gables Hotel in Lewiston on March 30 and 31, with a large number of drillers in attendance.

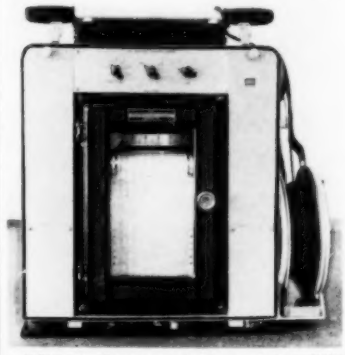
Committee meetings were held on the 30th followed by entertainment in the evening sponsored by the Sanderson-Cyclone Company and L. B. Smith. Saturday was devoted to the business of the association, the distribution of prizes to the members and inspection of the manufacturers' exhibits.

The noon-day lunch was attended by 200 members and friends. During the afternoon following committee reports the group was addressed by Dr. A. W. Ganger of Pennsylvania State College, Mr. J. R. Hoffert, Chief Engineer, State Board of Health, and others.

The newly elected officers for 1951-52 were installed to end a most successful meeting at the close of this group's first year of permanent organization.

MONTANA MEETING

The annual convention of this association is being held June 18 and 19 at the Civic Center in Lewiston, Montana. Headquarters for the group is the Fergus Hotel though arrangements for displays and the meetings will be at the Civic Center. Mr. L. E. Anderson of Billings is Secretary-Treasurer.



"Fig 6—Light weight portable field unit used in obtaining electric logs."

IDAHO MEETING

At a recent meeting of the Board of Directors of the Idaho Drillers Association held in Boise, legislation concerning ground water which was pending in the 31st session of the Idaho Legislature was discussed. Senate Bill 123 having been offered as a ground water code for Idaho was carefully considered and in general met with the approval of the Board. The matter of drillers' licenses was taken up an dthe Board recommended an amendment to the bill to provide for a licensing and a fee of $5.00 with renewal at $2.00 per annum.

Applications for new memberships were considered, also the method of reinstatement of old memberships. The matter of arrangements for the annual convention to be held at Burley, Idaho, June 11 and 12 were completed by appointing a convention committee. Mr. W. D. Bowler of Boise, Idaho, is Secretary of this association.

FLORIDA ASSOCIATION

A quarterly meeting was held Saturday, April 7, at the Lamar Hotel in Orlando. Mr. Earl Van Every of Orlando is Secretary.

MISSOURI MEETING

The 15th annual convention of the Missouri Water Well Drillers Association was held in Sedalia, Missouri, on April 16 and 17 at the Hotel Bothwell.

The first morning was devoted largely to a business meeting. This was followed by lunch and a technical session in the afternoon. During this meeting several speakers discussed subjects of interest to the drillers. The annual banquet and entertainment in the evening brought out a large number of drillers and their friends.

The meeting closed at noon on the 17th after all business had been taken care of and cash drawing held for members. The next convention will be held April 14 and 15, 1952, in Rolla at the Missouri Geological Survey and Water Resources Building.

Mr. J. N. Katyal operates a Failing 314 rotary rig near Karnal, Punjab, India. Mr. Katyal is an experienced operator having designed a tool for taking undisturbed formation samples with rotary equipment. Most of his work is either exploration drilling for large structures or water wells for domestic use. The picture shows the rig in operation with Indian labor. Look close and you can count thirteen people in the picture.

The following officers were elected for 1951: Ben H. Dake, Mountain Grove, President; Paul Clark, Fenton, Vice-President; Roy Wallace, Rolla, Secretary; Charles Wise, Kirkwood, Treasurer. Three directors were also chosen to serve with the new officers; Dale L. Fuller, Rolla, is Service Secretary.

OKLAHOMA MEETING

The annual spring meeting of this association was held in the Historical Society Building Auditorium in Oklahoma City, May 18. The program committee at an earlier meeting had provided for speakers on a number of subjects, all of interest to well drillers. Time was provided for a short business meeting and reports of committees before the meeting adjourned late in the afternoon. Mr. L. J. Clarke, c/o State Department of Health, is Secretary, and Mr. R. D. Sawyer of Chickasha, President.

INDIANA MEETING

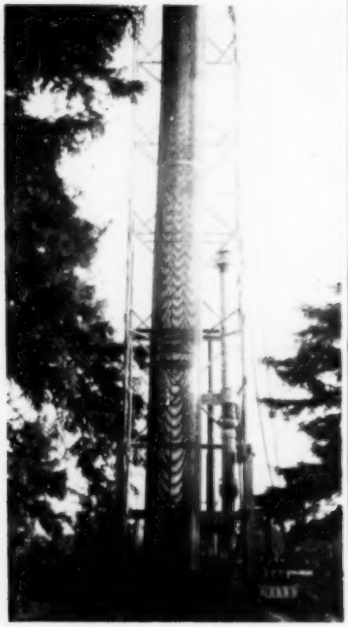
This group held its 20th annual convention at The Athenaeum in Indianapolis, April 24, 25 and 26, with a large number of drillers and manufacturers present.

The program which had been prepared was carried out, even to the part provided for the ladies which resulted in a ladies' auxiliary being organized. Mr. and Mrs. Harold Armstrong of Battle Creek were present to help get the movement started.

During the meeting speakers from the State Conservation Department and the State Board of Health appeared with timely talks and suggestions. The Peerless

(Continued on Page 15)

"Indiana Well Drillers Association—annual meeting at The Athenaeum—Indianapolis—April 25, 1951."



Gaudio Drilling Company setting 20 feet of 24-inch screen for Lakewood Water District, Tacoma, Washington, in well 175 feet deep. The well was constructed under the supervision of Robinson and Roberts, Ground Water Geologists, and produced 3,000 g.p.m. with 60 feet of drawdown.

ADVERTISEMENTS

We will insert advertisements for drilling equipment wanted or for sale, help or work wanted, etc., for our readers, free of charge. Advertisements must be brief, and we cannot assume responsibility for them, but will be glad to put parties in touch with each other by this means and suggest that they investigate any offers or inquiries carefully for themselves.

FOR SALE: One 35-W Armstrong drilling rig semi-truck mounted with equipment, ready to go; in good shape. Phone or write: Perkins Well Company, St. Paul Park, Minnesota, telephone LaSalle 268.

FOR SALE: Truck mounted rotary drill, Franks 1000-ft. capacity drill, complete, tools, pipe, etc. Priced to sell. Write: Fred E. Butler, Box 1832, Casper, Wyoming.

FOR SALE: One No. 26 Cyclone drill, in good running condition with Continental 4 cylinder motor; price $1,000.00. String of 4-in. tools $250.00 extra. Write: Ralph R. Smith, Route 3, Barberton, Ohio.

WANTED: Driller to operate a Bucyrus-Erie rig, drilling holes from 5-inch to 20-inch. Have plenty of work and casing on hand. Good wages for right party. Write or telephone: Chas. D. Nolan, 1003 20th St. S. E., Cedar Rapids, Iowa, telephone 2-7644.

WANTED TO BUY: One set of 2½-in. drill jars, in good shape; also one No. 60 all steel Howell drilling rig. Write: John M. Wolf, Napoleon, N. D.

FOR SALE: One well auger mounted on 6x6 Studebaker truck, purchased new 1949, drills up to 36-in. hole, complete with 100-ft. drill rod, rig practically new; price $3,500.00. Write: Columbia Pump & Well Company, 232 Gallatin Street, N. W., Washington 11, D. C.

FOR SALE: One Howell No. 60 all steel drill; shock absorber, near new power plant; trailer type on pneumatic tires. Write: Alton Cement Works, Alton, Iowa.

FOR SALE: One drilling machine all steel with swivel socket, drive clamps, drive head and tools 5 to 13 in., bailer and sand pump, jack and circle, chain tongs, fishing tools, F.W.D. truck 4 wheel drive '38 model, one International truck 12 foot steel bed '47 model; $3,000 takes all; reason for selling, too much competition with cut-throat prices; will sell all together or separately. Write: Orion Casto, Box 309, Ripley, West Virginia.

FOR SALE: One Ideco No. 6 drilling rig with 31-ft. telescoping derrick, mounted on '37 Chevrolet 1½-ton truck, drilled only seven wells; one Star drilling rig No. 40—28-ft. derrick mounted on '41 International 1½ ton truck; few strings of 4-inch tools, one string 6-in. tools, 1 string 3-in. tools, also fishing tools; one 1941 White 1½-ton truck and one 1941 ½-ton Ford Panel truck. Will sell home and business also on account of failing health. Telephone 77F14, Fulton, Indiana, or write: Richard Henderson, R. R. No. 2, Kewanna, Indiana.

FOR SALE: Used pumps, one 20 H.P. Deming pump 8-in, 300 g.p.m. at 176 TDH; one 8-in. 25 H.P. 350 g.p.m. pump at 172 TDH; and one 10-in 60 H.P. pump 750 g.p.m. at 256 TDH; all equipped with 3 phase, 220 volt, 1800 RPM, U. S. motors; discharge head and bowl assemblies; there are no columns or shafts with these pumps; all guaranteed as new. Write: Connecticut Pump Company, 59 Broadway, North Haven, Conn.

FOR SALE: For half price of new, two drill stems, 5x5 carbon steel bits; two sets drill jars; two swivel rope sockets; one set heavy drill wrenches; one derrick crane; one set wire rope clamps; one slip socket; two gasoline pump jacks engines; and other miscellaneous tools. Write: Gray Well Drilling Company, P. O. Box 181, Delafield, Wis.

FOR SALE: No. 40 Sanderson-Cyclone, less than year old, equipped with 2 - 4-in. Howell pumps for jetting; complete set of hollow rod tools; requires no alteration to handle solid tools; four wheel trailer mounted; several thousand feet of 1¼, 2, 3, and 4-in. pipe will go with rig if desired; also 1940 Dodge truck, 1½ ton, two speed axle, hydraulic hoist, new motor last August. Write: Carl B. Olsen, Medora, North Dakota.

FOR SALE: 211 feet of 5⅜" S & S casing threaded and coupled; never used. Write: Leo Lutz, Osceola, Wisconsin.

WANTED: Two experienced drillers and also two helpers immediately. Write: T. W. VanWinkle & Son, Salem, Iowa.

WANTED TO BUY: Used 28-L or 24-L Bucyrus-Erie rig in good condition, mounted on trailer. Write Box A, c/o Edward E. Johnson, Inc., 2304 Long Ave., St. Paul 4, Minnesota.

FOR SALE: One 21-W Bucyrus-Erie drilling rig mounted on Model A Ford car; recently overhauled, complete with 500 feet of drilling cable, powered by Wisconsin 26 H.P. engine, price $2500.00; also one home-made drilling rig with 35 ft. mast, braces, etc., mounted on 1940 International truck, powered with Wisconsin 26 H.P. motor, price $2650.00. Write: William Mantyla, R.R. 4, Stillwater, Minnesota, or telephone Cottage Grove 2311.

FOR SALE: One 42 Cyclone drill equipped with 36-ft. derrick, catheads; mounted on 1942 Chevrolet Army truck; can be purchased with or without tools; located at Zanesville yard; also one 26 Cyclone drill located in Canton; one 240 Star drilling machine, located in Springfield; one 22-W Bucyrus-Erie drill equipped with 36-ft. mast, with or without truck, located in Vandalia, Ohio; any of these machines can be inspected at your convenience including Sundays. Call or write: The Buckeye Supply Company, 18 Harrison Street, Zanesville, Ohio, phone 2-3641.

FOR SALE: No. 6 Ideco Spudder; one year old, mounted on '39 Chevrolet, 31-ft. telescoping derrick; power derrick hoist; International 4 cylinder motor, with or without tools. Ready for work. Write: H. R. Tracy, 29200 Greening Blvd., Farmington, Michigan, or telephone Mayfair 6-2492.

DRILLER WANTED: Have opening for one or possibly two drillers to operate cable tool rigs in Virginia and North Carolina. Formations include hard rock, mud and sand drilling. Permanent employment. This is excellent opportunity for the right man. Write: Sydnor Pump and Well Company, Inc., P.O. Box 1476, Richmond, Virginia.

FOR SALE: Two drilling machines, one 4-inch and one 2-inch. Write: L. B. Leverich, Route 2, Edgerton, Ohio.

WANTED TO BUY: Finger clutch for five-foot bull wheel, should be two feet across or more. Please quote price wanted. Write: Orval Wright, Wiarton, Ontario, Canada.

FOR SALE: One Star drilling machine No. 32, wood frame and derrick mounted on Gramberstein long wheelbase truck, dual solid rubber tires.

One Star drilling machine No. 32, wood frame and derrick, round steel traction wheels with cleats and mud hooks. Both machines powered with LeRoi motors, reduction gears and clutches. Two complete strings of tools for 4 and 6-inch holes. Also one 15-foot 4½-inch stem, 2x3 API joints complete, four 6-inch bits, two 8-inch bits, walking beam temper screw with clamps for rope and wire line walking beam, chain wrenches, ratchet jacks, screw jacks, pulling rings with slips for 4-inch and 6-inch casing elevators for four 4¼-inch, six 6¼-inch casing rope spear boot latch combination socket casing, jars, rope, knife, one O-W-S packer for 4-inch casing to go in 6-inch hole, drive clamps for three stems. Will sell all for $2,500.00. Write: J. L. Rice, East Canton, Ohio.

FOR SALE: 20 ft. by 20 ft. Aluminum drilling shanty; one Bucyrus-Erie 28-L Spudder semi-trailer mounting with 54-ft. derrick; machine a little over two years old; in good shape; also drill stems; 6 miscellaneous bits; two bailers, jack, and circle with wrenches and other miscellaneous tools; 2,000 ft. of ¾-inch drilling line and ½-inch sand line; one 1948 model K-7 International truck. Write: Ray S. Knapp, 8845 Main Street, Clarence, New York.

WANTED: One 5-inch drill bit, joint size not important. Write: Sydney Christenson, Cromwell, Minnesota.

WANTED: 71 Star, 22-W or 24-L Bucyrus-Erie, 42 or 44 Cyclone, or similar machine with or without truck or tools. Write description and price: Glass Drilling Company, R.R. 2, Greensburg, Indiana.

WANTED TO BUY: Second-hand drilling rig, 22 Bucyrus-Erie mounted on truck with drilling and fishing tools for 8-inch to 14-inch holes. Write air-mail giving details to: Federico L. Gonzalez, Motolinia 20-401, Mexico City, Mexico.

FOR SALE: One home-made well drilling machine with 12-in. cathead; two 4-inch jet pumps, mounted on Dodge truck with Chevrolet motor power; jetting hose; some pipe; and 186 feet drill rods. First offer of $900.00 takes. Write: Louis Schlacht, Monticello, Minn.

WANTED: Driller, we have opening for one or possibly two drillers to operate cable tool rigs in Northern Illinois. Formations include gravel, sand and rock drilling. We believe this excellent opportunity for the right man. Also wanted experience pump installation and repair man. Write: Henry Boysen, Jr., Route 21, Libertyville, Illinois.

FOR SALE: All steel well drilling machine, similar to 21-W Bucyrus-Erie; mounted on four-wheeled trailer, carrying 600x16 tires; 300 ft. ⅝ in. cable, 300 ft. of new ⅜ in. sand line cable, 4 in. Bucyrus-Erie drill and bailing bucket; may be seen at work; full information and pictures sent on request; $800.00. Write: Marcus Blair, Evergreen, Alabama, Phone 198M.

FOR SALE: Drilling business; 71 Star good condition, trailer mounted; string of 6 in. and 4 in. tools, other miscellaneous drilling tools; Mills perforator for perforating 10 in. and 14 in.; '46 G.M.C. ton and half truck, equipped with winch, A-1 condition; single axle logging trailer for handling pipe, 4-cylinder, air-cooled Lincoln welder, 150 amps; 16-foot trailer house equipped with butane stove and refrigerator; small three-room house, not modern, and tool yard; located on main highway. Price $8,700.00. Write: F. R. Williams, Box 1336, Lakeview, Oregon.

FOR SALE: 1,500-ft. capacity Failing drill, complete with drill rod, tools, etc., can be seen operating near Thermopolis, Wyoming; also 1,000-ft. capacity Sullivan mounted on 46 - 2½-Ton G.M.C. Write: Fred E. Butler, Box 1832, Casper, Wyoming.

ASSOCIATION NEWS

(Continued from Page 13)

Pump Company also entertained the group with a trip through its plant and a buffet lunch.

The high-light of the meeting was the annual banquet held on Wednesday evening at the Athenaeum and followed by dancing.

The following officers were elected: Walter Gordon, Churubusco, President; H. K. Carr, Greentown, Secretary; J. H. Dilden, Dayton, Vice-President; Richard Hill, Director; and Melvin Hahn, Nappanee, Treasurer.

WISCONSIN MEETING

The 23rd annual meeting of the Wisconsin Association came to order at Green Bay, April 19, followed by an address of welcome by the Mayor. Mr. George Galloway, President, presiding, carried the program out as planned. Mr. O. J. Muegge and others appeared for the State Board of Health, Prof. E. F. Bean, State Geologist, spoke on Oil Well Drilling in Wisconsin. He was followed by William J. Drescher of the U. S. Geological Survey, Robert D. Brown of Halliburton Cementing Company, and R. C. Woodward of the Bucyrus-Erie Company on "Heat Treatment of Drill Bits."

The following day was devoted to an open adjourned public hearing by the State Board of Health on a Revised Well Drilling Code and the annual business meeting of the Association. The new Board of Directors will select the officers to serve for the coming year.

The meeting closed with the annual banquet and dance at the Northland Hotel on the evening of Friday, April 20, after one of the most interesting and enjoyable meetings held in recent years.

EMPIRE STATE MEETING

A regular meeting of this association was held at the Nelson House in Poughkeepsie on Wednesday, April 11.

The meeting started at 2 p.m. with Mr. Cox from the State Department of Health on the subject "Civil Defense and the Water Supply." A turkey dinner was held at 7 p.m. following the meeting and a drawing of door prizes. Robert Klindt, Oneonta, is Secretary of this group. The next meeting will be in the Buffalo area in July.

NEW ENGLAND MEETING

A group of drillers in the New England states have been interested for some time in the organization of a drillers' associations. A preliminary meeting was held late last year to form a temporary organization. This group has now formally adopted a constitution at a meeting held in Worcester, Massachusetts, on March 22, 1951. The temporary officers were elected to serve the first year. Edwin H. Hartley, Turners Falls, Massachusetts, is President; Vincent Sullivan, Oakland, Massachusetts, is Secretary. Directors are from various towns in Connecticut, New Hampshire, Maine, Vermont, Rhode Island, and Massachusetts.

VIRGINIA MEETING

The committees of this association in conjunction with the officers are at work to obtain more pipe for Virginia well drillers. The membership committee is also busy with plans to increase the number of members.

The annual meeting will be held at Richmond, October 5 and 6, with ample space available for meetings and exhibits. Mr. Julian Perry, 1319 E. Main Street, Richmond, will take care of requests for information about the meeting.

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